BAY BRIDGE DESIGN TASK FORCE
ENGINEERING AND DESIGN ADVISORY PANEL

Draft Design Criteria for the
East Span Replacement of the
San Francisco Oakland Bay Bridge

General Requirements

The new span will be constructed in a manner to allow continued operation of the existing span with a minimum amount of time upon completion to transition to the new span.

The bridge will be designed to provide normal traffic service (lifeline service) after an earthquake on either the Hayward or San Andreas fault systems.

The existing level of traffic flow service shall be maintained — five lanes of traffic in each direction with a standard shoulder on at least the right side in each roadway.

Geometry will be compatible with the existing facilities which must be matched in location as well as grade and curve.

Access will be provided to Yerba Buena Island (YBI). The new design should be as compatible as is reasonable with present use and future development of YBI (e.g., United States Coast Guard (USCG) and the City of San Francisco island use plans)

A single clear portal 42 meters (138 feet) vertically above the mean high water level and 143 meters (500 feet) horizontally between fenders will be provided for marine traffic just east of YBI. (The USCG will make the final determination.)

The existing bridge will be removed after completion of the new span.

The scope yet to be determined by the Bay Bridge Design Task Force and the Metropolitan Transportation Commission after public hearings and in consultation with the Bay Conservation and Development Commission (BCDC) and Caltrans includes:

- the width of the shoulder, if any, on left side of the roadways,
- the addition of pedestrian and bicycle facilities,
- the accommodation for future rail.

Design Considerations

The bridge should integrate into the site and the surrounding environment by reflecting the grand scale of the San Francisco Bay, by harmonizing with the existing west span of the bridge and by landing gracefully on the Oakland and Yerba Buena Island landfalls. The new east span design should reflect design continuity within itself and should be harmonious with and complement the retrofitted west span structure.

The design of the replacement span should adhere to the established principles of design so that the structure's form, alignment, and detailing exhibit continuity and order. The bridge and its members should be scaled in harmonious proportions to one another. Order should be achieved by limiting the direction of lines and edges in space, and by establishing a consistent rhythm of spans, column size, span depth and spacing of elements. The design should be so refined that no element can be added or removed without disturbing the harmony of the whole.

The new bridge should achieve a clean and well-defined anatomical construction, devoid of any deception and unnecessary detail, and with directness of line both pleasing to the eye and responsive to the senses. The bridge design should not be a gratuitous fashion statement, but should resolve itself in a timeless manner suitable to its central prominence in the Bay. The structure design should exhibit a natural balance and form in a manner which leads to the least possible disturbance of the Bay and its shoreline.

Where spans or structural systems change within the new east span, structural system integration will be important for visual continuity, using a consistent vocabulary within the different systems for design continuity and integrity.

The alignment of the roadway into and out of the tunnel on the east side should be improved. The abrupt angle of the existing east span bridge at the tunnel is awkward. The alignment of the new bridge should provide a safe, easily driven alignment that also enhances the user's view of the Bay and the surrounding land forms. The ascent of the bridge from the Oakland landfall to Yerba Buena Island should be consistent and should flatten out before the tunnel so that the bridge gracefully engages the island and the tunnel as viewed from available vantage points.

If a double level roadway is considered, it will need to be an open truss design for view and light considerations and consistency with the west span.

The design for the east span should reflect that the existing two-level truss is a very strong, unifying element between the east and west spans, both because it projects from San Francisco to Oakland, interrupted only by the Yerba Buena Island tunnel and because it visually establishes a very strong line from one end to the other.

The bridge should provide a measure of visual continuity for motorists, regardless of what structural system is used, equal to, but not necessarily the same as, that of the existing westbound portion of the east span bridge, which establishes a visual continuity for motorists because the trusses maintain a consistent rhythm of form, creating a lacy tunnel through which motorists pass.

Any bicycle and pedestrian way should be integrated into the bridge design so that it contributes to the overall order and continuity of the bridge design. Periodic outlooks should be provided at intervals along the bicycle-pedestrian way.

The girders, piers and rails of the bridge should generally appear slender and should provide for views of the Bay by motorists using the bridge.

Guard rails and hand rails should be designed to provide maximum transparency for maintaining views of the Bay while meeting appropriate safety criteria.

Large expanses of concrete surface on the new span should be textured. A concrete bridge should be colored in such hues as off-white, tan, reddish brown, or gray if possible.

Landscaping around the bridge should replicate the existing natural surroundings of the Bay shoreline.

Environmental

The design should strive to minimize impact to the bay and to Yerba Buena Island (YBI)

The new span should be aligned minimize, and mitigate impacts on sensitive wetland areas in the Emeryville Crescent.

The design should minimize bay fill and dredging.

Design and construction impacts on wildlife should be minimized and mitigated — many species of wildlife could be impacted by this project including the peregrine falcon, winter-run Chinook salmon, double-crested cormorant, least tern, clapper rail, pacific herring, and harbor seal. Removal of the nesting sites during selected times of the year will impact the birds, dredging during selected times of the year may impact the fish, and boat access may impact the harbor seals. Additionally, nesting sites for both the peregrine falcon and the double-crested cormorant should be sustained on or near the new span.

Replacement bridge foundation locations should, to the extend feasible, avoid known prehistoric, potential historic archaeological sites and historic properties on YBI.

Highway design standards

The following geometrics on the bridge roadway will be maintained:

- design speed of 100 kilometers per hour (65 miles per hour)
- maximum allowable deck grade of 2.74% (the existing maximum grade)

- minimum horizontal curve radius on mainline of 1000 meters (3000 feet) (based upon Stopping Site Distance (SSD) and is function of 3 meter shoulders — this number maybe modified depending on final determination of shoulder widths)
- minimum right side shoulder width of 3 meters (10 feet)
- lane width of 3.6 meters (12 feet)
- maximum superelevation rate of 0.04 meters/meter for a 1000 meter curve
- the stopping Site Distance (SSD) is 190 meters as a function of a 100 kilometers per hour speed
- minimum vertical curve length of (2V) in which V equals the design speed
- minimum horizontal clearance of 3 meters (10 feet) (which may change dependent on final determination of shoulder widths
- minimum vertical clearance of 5.1 meters (16.5 feet).

The following geometrics on the bridge ramps will be maintained (conforming to the island may cause some compromises of these standards):
- minimum design speed at an exit nose 80 kilometers per hour (50 miles per hour)
- minimum design speed at a terminus of 40 kilometers per hour (25 miles per hour)
- lane widths of 3.6 meters (12 feet)
- right shoulders of 2.4 meters (8 feet)
- left shoulders of 1.2 meters (4 feet)
- Stopping Site Distance of 130 meters (430 feet) as a function of a 80 kilometers per hour speed (50 miles per hour
- maximum allowable deck grade on a ramp of 8%
- maximum superelevation of 12% for a curve radius equal to or less than 190 meters (625 feet)

<u>Pedestrian-bikeway design standards</u>

If included, the pedestrian-bikeway will follow the following standards:

- be separated from motorized traffic by a barrier
- minimum width of paved path from barrier to barrier of 3.6 meters (12 feet)
- minimum vertical clearance of 2.5 meters (8 feet)
- minimum bicycle path design speed of 40 kilometers per hour (20 miles per hour).

<u>Bridge Structural Considerations</u>

The design should anticipate potential inefficiencies of the foundations in bay mud.

For efficient span lengths and foundations a configuration is selected by envisioning an efficient foundation design in which group efficiency is high (i.e., few piles and/or large pile spacing) and few, if any, <u>additional</u> piles are required for load case VII beyond required piles for load cases other than load case VII (i.e., foundation service loads are increased by increasing span lengths until required capacities due to service loads are near to required capacities due to the seismic load case).

The above described design process will generate several different span lengths as the soils and height of the roadway vary. If the relatively great variation in structure type of the existing east spans is to be avoided, a degree of compromise should be anticipated between economy and structure type continuity in pursuit of structure continuity.

Desired span lengths tend to define superstructure type, first by feasibility and then by economy. Minimum depth-to-span ratios must be respected in order to avoid compromising camber prediction methodologies and live load deflection limiting criteria.

Post-Earthquake performance of the new structure should be high. The new structure should be capable of carrying emergency traffic as well as normal traffic. (Some damage is expected — e.g. minor plastic hinging and thermal deck joints requiring replacement.)

Damage to the structure during a large seismic event should be managed (i.e., location and quantity controlled by design). No damage in the foundation should be tolerated as it cannot be easily accessed. Even if the design plans for no damage in the system, design of a fuse for location and ductility should be completed. In the very best of seismic designs, this challenge is met with simplicity yielding a high confidence in performance rather than with sophisticated analysis of relatively complex behaviors.

On stiff sites the structural system should be soft and on soft sites the structural system should be stiff.

Force reduction factors used for sizing members should be no greater than 3.0. (ref. ATC-32)

Bridge response to seismic ground motions are likely to be dominated by a velocity pulse. A rocking system should be considered to minimize damage and plastic deformation at the time of a pulse and following an earthquake.

Torsional capacities within the superstructure must be capable of carrying seismic demands.

Drop-type vulnerabilities should be avoided and elimination should be considered.

The type selection should respect constructability and the capacity to maintain quality assurance.

Maintainability

Long term maintenance must be considered. The selection of structure type, a variety of potential system components, and structure materials should consider necessary maintenance programs and evaluate the likelihood of such programs receiving necessary consistent funding.

Maintainable thermal expansion joints will be required but should be at a maximum spacing consistent with bridge movement.

Box 7, Folder 6

Item 1